Transportation Synthesis Report

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Construction and Operations Applications For Radio Frequency Identification (RFID)

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Transportation Synthesis Reports (TSRs) are brief summaries of currently available information on topics of interest to WisDOT technical staff in highway development, construction and operations. Online and print sources include NCHRP and other TRB programs, AASHTO, the research and practices of other state DOTs, and related academic and industry research. Internet hyperlinks in TSRs are active at the time of publication, but changes on the host server can make them obsolete.

REQUEST FOR REPORT

A young technology with considerable commercial buzz, RFID – radio frequency identification – allows rapid and accurate reading of tags which, unlike UPC bar codes, can be read from a distance, in harsh environments, and through many materials without a direct line of site required. In uses that employ the small and increasingly inexpensive RFID tags, the radio signal sent in search of tags provides energy sufficient for a response from the tags, thereby eliminating the need for an internal tag power source.

The RD&T Program was asked to carry out a preliminary scan of RFID applications in transportation, particularly highway construction. We also include references to applications in traffic management and inventory control where RFID use is more mature. Tolling stations, speed monitoring, trip tracking, and transit payment are the main operations-related uses at this point. These haven't, it appears, been integrated fully with ITS programs, though this is certainly coming; many of the vendors of RFID offer ITS and traffic management products and/or services, as well, and integration seems imminent.

More intriguing and pertinent to highway construction is the use of RFID tags to monitor material properties. A materials engineer with Michigan DOT turned to the private sector for help developing concrete monitoring applications. A tag is embedded in concrete and monitors temperature, which data can be used to assess developing strength and curing rates for quality control.

Other uses have been suggested, though not described in detail, on commercial Web sites and in lectures. For example, RFID is mentioned as a tool for identifying road construction materials and monitoring timber quality.

CONSTRUCTION APPLICATIONS

The use of RFID to inventory non-bulk construction materials continues to develop, but the most interesting use of RFID is for monitoring fresh concrete temperature.

Concrete Maturity Monitoring System. International Road Dynamics developed a system using RFID and software to monitor concrete properties via temperature readings. Placed in the pour, the five-inch long tag gathers temperature data which it transmits for use in determining concrete strength and curing rates. The idea originated with Tim Stallard, a Michigan DOT materials engineer. See the MDOT report at http://www.wakeinc.com/pages/mich2004.pdf. See also http://www.wakeinc.com/pages/conmat.html, http://rapidttp.com/transponder/presre73.html, http://www.irdinc.com/english/html/corp/business_update/2004/040430.htm, http://www.tac-atc.ca/english/informationservices/tacnews/summer2004-17.HTM, http://www.construction.com/NewsCenter/Headlines/ENR/20040621m.asp, and

http://www.identecsolutions.com/pdf/Newsrelease_IDENTECSOLUTIONSwinsNOVAAward.pdf. See also a reprinted Detroit News article on Stallard's work on a concrete maturity meter, http://www.wakeinc.com/pages/conmat4.html. This piece cites another project, in Okla., using RFID to monitor concrete curing, and claiming a savings of two days work per pour. It also notes the use of RFID to inventory pipes loaded on trucks as the trucks pass a station; this may be adapted for road construction uses.

Berkeley Lecture. From a presentation by a professor from Arizona State University, UC-Berkeley posted a four-page lecture transcript. Note on page two, under "Issue Number 3," a description of construction applications for RFID that include robotic construction and materials monitoring, and guiding, monitoring, and coordinating functions. http://www.ce.berkeley.edu/~tommelein/CEMworkshop/Schexnayder.pdf.

STId. This French company lists advantages of RFID over barcodes – easy reading, durable, reprogrammable – and applications which include road construction and timber grade monitoring. We include the latter because it, like the Korteks "material identification," below, suggests a capability in describing or analyzing material characteristics. http://www.stid.com/en/index.php3?canvas=/en/html/technology.html.

Korteks. An application stated but not described is "road construction material identification"; it may be inventory control, but in light of the above, it may entail applications in identifying material characteristics. http://www.korteks.com/Applications/Applications_TOC.htm.

Inventory Tracking. FIATECH today announced a report called *Materials and Asset Tracking Using RFID: A Preparatory Field Pilot Study*. The study tracked Chevron Texaco Marine and Transportation shipping containers from warehouse to offshore locations. Container tracking is a commercial application oft cited by RFID proponents. See press release at http://www.magnetmail.net/actions/email_web_version.cfm?recipient_id=1266473&message_id=57550&user_id=fiatech and order reports on the FIATECH Web site at http://www.fiatech.org/.

TRAFFIC MANAGEMENT AND SAFETY APPLICATIONS

The tracking potential of RFID applications has seen its development in traffic management and ITS systems for several years.

NCHRP. A 2006 NCHRP research project will consider RFID as a vehicle identification tool for use providing information services to drivers, determining trip patterns, mitigating urban congestion, tracking travel time and speed, weigh station bypasses. The report suggests a variety of traffic management applications may emerge. See http://depts.washington.edu/ahb20/research/4Feb2004/AVITrafficMgmtFinal.pdf.

RFID Journal. An April article praised RFID's applications for traffic safety, including sending drivers alerts to weather or traffic problems, or warnings about speed. See http://www.rfidjournal.com/article/articleview/866/1/1/.

TransCore. This firm offers various ITS applications of software, hardware, and consulting, numbering Florida, Georgia, and New York City as clients. See its ITS products link, http://www.transcore.com/markets/advanced_traffic_management.htm, ATMS link http://www.transcore.com/whoweare/atms/atms_key_installations.htm, and transportation management link http://www.transcore.com/markets/transportation_management_systems.htm. Products eGo and Amtech can link RFID to various monitoring systems in cars, conveying data about speed and other behaviors, applications that appear adaptable to ITS needs. See http://www.transcore.com/technology/techapps.htm and http://www.transcore.com/technology/eGo.htm.

Electronic Design. A 2001 article on ITS that seems somehow current, this describes RFID being used for toll collection in Dallas, and claims the technology can be used to identify vehicles for ITS tracking and speed tracking; http://www.elecdesign.com/Articles/ArticleID/4333/4333.html. See, too, the image of Dallas toll RFIDs manufactured by TransCore's Amtech unit -- http://www.elecdesign.com/Files/29/4333/Figure_02.jpg.

South Africa. Uses for an RFID strip affixed to car windows include traffic, speed, and border control, road toll collection, and parking management. http://www.rfidjournal.com/article/view/1078.

London, England. The city's transit authority uses RFID in its transit cards. http://www.itsworld.com/tme/index.cfm/powergrid/rfah=%7Ccfap=/CFID/643820/CFTOKEN/43234909/fuseaction/showNewsItem/newsItemID/5346.